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## ABSTRACT

This study explores computer-mediated tutoring and a traditional tutoring model that is carried out on a face-to-face basis and investigates whether there is a difference in high school students' mathematics achievement. In this study, there was no statistically significant difference between the face-to-face and the computer-mediated tutored students' mathematical achievement, and there was no significant difference between the students who had less than 10 tutoring sessions and students who had more than 10 tutoring sessions with regard to their mathematical achievement. The results imply that computer-mediated tutoring can be as effective as face-to-face tutoring with mathematical concepts.  
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Face-to-Face and Computer Mediated Tutoring: A Comparative Exploration on High  
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Too many United States students are finishing high school without mastering the challenging mathematics for success in higher education (The National Commission on Mathematics and Science Teaching for the 21<sup>st</sup> Century, 1999). Deborah Ball, Commission Member and Professor of Mathematics Education and Teacher Education at the University of Michigan, states that the dynamic relationships between teacher, students, and content are what produce differences across lessons. Understanding these relationships is key to thinking about strategies for improving instruction (The National Commission on Mathematics and Science Teaching for the 21<sup>st</sup> Century, 1999).

Research has shown that tutoring can have a variety of positive impacts in the educational arena: better class behavior (Kerka, 1998; Nazzal, 2000); better school attendance (Carmola, 1995; Kellner, 2000); improved relationships with adults and peers (Nazzal, 2000); significant gains in student mathematical achievement (Bennett et al., 1998; Ritter, 2000); increased enrollment and performance in college preparatory mathematics and advanced mathematics classes (Wighton, 1993); improved student overall academic achievement (Center for Intergenerational Learning Study, 1996; Lauand, 1998); and a better understanding of the course materials (Boswell and Dankosky, 1997; Dennis, 1998; and, White, 2000).

A traditional tutoring model is carried out on a face-to-face basis – student and teacher getting together in a specific place when both have the time. Tutor and tutee are limited with respect to space and time (Dennis, 1993; Nellen, 1999; Wighton, 1993). With the advent of computers, tutoring can also be accomplished through electronic mail. This type of tutoring allows for convenient, consistent, and frequent communication between tutor and tutee. Tutor and tutee are limited to computer access but not to

specific space nor an agreed upon time (Dennis, 1993; Goldman, 1997; Nellen, 1999; Wighton, 1993). Through a continuous association, the tutor offers support, guidance, and assistance as the tutee goes through a difficult phase, faces new challenges, or works to correct earlier problems (Bennett et al., 1998; Boswell and Dankosky, 1997; Center for Intergenerational Learning Study, 1996; Dennis, 1998; Goldman, 1997; Kellner, 2000; Kerka, 1998; Lauland, 1998; Nazzal, 2000). The role of a tutor can be considered to be a guide, supporter, teacher specialist, teacher coach, helping teacher, support teacher, and encourager (Dennis, 1998; Lauland, 1998). Through continued involvement, the tutor offers extra instructional help in subjects where improvement is needed. He or she gives guidance, knowledge, and encouragement to someone who is learning.

Computer mediated tutoring allows for expedient, steady, and daily communication between students and teachers besides creating an archive of all communication that has taken place between the tutee and the tutor (Neils, 1998). Hewlett-Packard has conducted quantitative research on its E-mail Mentor Program and has observed that teachers notice increases in attendance, use of technology, self-confidence, involvement in school, and motivation at school among students involved in telementoring, as well as, enhanced career choices and improved grades (Neils, 1998).

#### Methodology

The students in this study were randomly assigned to two groups: the group of students who received face-to-face tutoring (control group) and the students who received computer-mediated tutoring (experimental group). Their achievement grade constitutes their first 9-week final grade. The researcher teaches all three mathematics classes.

Students in the control group came to the researcher's office between the hours of 9:30 a.m. to 11:30 a.m., Monday through Friday. Students in the experimental group contacted the researcher at any time and day. The researcher read and responded to the student sent electronic mail during the hours of 8:00 p.m. and 10:00 p.m. on weekdays and in the afternoon during the weekend. This meant that students in the control group had, on average, a two hour window to ask for and receive help, five days a week, while the students in the experimental group could post their questions any time during the day and receive their answers not only on a daily basis but also during the weekend. The type of questions posed by both the control and the experimental group students were similar. Both groups, the control and the experimental, received the same response to similar questions. The method utilized to answer the students' questioning was the same for both groups – guidance, knowledge, and encouragement was given in each face-to-face session or through each electronic mail. In all instances, it was only the space that demarcated the two tutored groups – a few feet in an office or in front of a computer and hundreds of feet away.

Based on these findings, the research question of this study is: Will there be a statistically significant difference in the Mathematics mean grade of students in the 11<sup>th</sup> and 12<sup>th</sup> grade at the School for Advanced Studies-North who receive face-to-face tutoring and those who receive computer-mediated tutoring?

This comparative study was conducted in a dual enrollment public high school housed at a public community college in Miami, Florida between August 2001 and November 2001. The mathematics achievement data for the study was gathered from 58 high school students in the 11<sup>th</sup> and 12<sup>th</sup> grade who are enrolled in a Statistics,

Precalculus, or Calculus class. These students must take Precalculus, Calculus, or Statistics as a junior at this dual enrollment public high school unless he/she took it as a sophomore at their home school. Only those students who completed Calculus or Statistics during their junior year are not required to take a high school mathematics class during their senior year. To be admitted to this upper level (11<sup>th</sup> and 12<sup>th</sup> grade) public high school, the student must have earned a 2.5 grade point average on a 4.0 scale during their 9<sup>th</sup> and 10<sup>th</sup> grade, have a good attendance record, the recommendation of a teacher and a counselor, have at least completed Algebra 2, and he/she must pass the ACCUPLACER/Computerized Placement Test (CPT) battery of the Florida College Entry-Level Placement Test for basic skills assessment. All students must take the reading, writing, and algebra sections of the CPT. Algebra test scores are used to determine if the student should take an arithmetic test or an advanced mathematics test. If a student scores below the State-mandated score on more than one portion of the test, he/she is not admitted into the program.

The hypothesis stated that students receiving academic assistance through face-to-face tutoring would obtain the same mean grade in mathematics as those students receiving academic assistance through computer-mediated tutoring.

In the control group, 13 students were taking Statistics, 9 were taking Calculus, and 6 were taking Precalculus, while in the experimental group, 5 students were taking Statistics, 14 were taking Calculus, and 9 were taking Precalculus.

Table 1: Distribution of Participants by Course

|              | Statistics | Calculus | Precalculus |
|--------------|------------|----------|-------------|
|              | <u>N</u>   | <u>N</u> | <u>N</u>    |
| Control      | 13         | 9        | 6           |
| Experimental | 5          | 14       | 9           |

In the control group, 22 students were in the 12<sup>th</sup> grade and 6 were in the 11<sup>th</sup> grade, while in the experimental group, 17 were in the 12<sup>th</sup> grade and 11 in the 11<sup>th</sup> grade.

Table 2: Distribution of Participants by Grade Level

|              | 12 <sup>th</sup> Grade | 11 <sup>th</sup> Grade |
|--------------|------------------------|------------------------|
|              | <u>N</u>               | <u>N</u>               |
| Control      | 22                     | 6                      |
| Experimental | 17                     | 11                     |

The majority of the students that participated in this study were females. In the control group, 19 students were females and 9 were males, while in the experimental group 22 students were females and 6 were males.

Table 3: Distribution of Participants by Gender

|              | Females  | Males    |
|--------------|----------|----------|
|              | <u>N</u> | <u>N</u> |
| Control      | 19       | 9        |
| Experimental | 22       | 6        |

In the control group, three students contacted the tutor less than five times, nine contacted the tutor between 6 and 10 times, 13 contacted the tutor between 11 and 15 times, and 3 students contacted the tutor between 16 and 20 times. In the experimental group, two students contacted the tutor less than five times, seven contacted the tutor between 6 and 10 times, 11 contacted the tutor between 11 and 15 times, and 8 students contacted the tutor between 16 and 20 times.

Table 4: Distribution of Tutoring Sessions Frequency

| Frequency           | Control  | Experimental |
|---------------------|----------|--------------|
|                     | <u>N</u> | <u>N</u>     |
| $F \leq 5$          | 3        | 2            |
| $6 \leq F \leq 10$  | 9        | 7            |
| $11 \leq F \leq 15$ | 13       | 11           |
| $16 \leq F \leq 20$ | 3        | 8            |

The control group had a frequency mean of 10.39 with a standard deviation of 4.07, while the experimental group had a frequency mean of 12.07 with a standard deviation of 4.36.

An independent samples t-test was performed on the data to determine if there was a statistically significant difference between the control and the experimental group for the main effect on mathematics achievement. The independent samples t-test showed a t-value of -0.30 with a p-value of 0.766 (\* $p < 0.05$ ) when the achievement for the treatment group was compared to the achievement of the control group. (See Table 5)

Based on this p-value, it can be concluded that there is no significant difference in the mean mathematics grades between the students receiving face-to-face tutoring, and those students receiving computer mediated tutoring.

Results were interpreted at the 0.05 level of significance. The generalizability of the findings may be limited because all students attended the same dual enrollment high school.

Table 5: t-test for Independent Samples of Method

| Variable     | <u>N</u> | Mean    | <u>SD</u> | <u>t</u> | 2-tail Sig |
|--------------|----------|---------|-----------|----------|------------|
| Control      | 28       | 76.4643 | 8.487     | -.30     | .766       |
| Experimental | 28       | 77.1071 | 7.554     |          |            |

Figure 1 shows a boxplot of scores of both groups. The control group had a minimum grade of 61 and a maximum grade of 96 with a median grade of 75, while the experimental group had a minimum grade of 60 and a maximum grade of 93 with a median grade of 76.

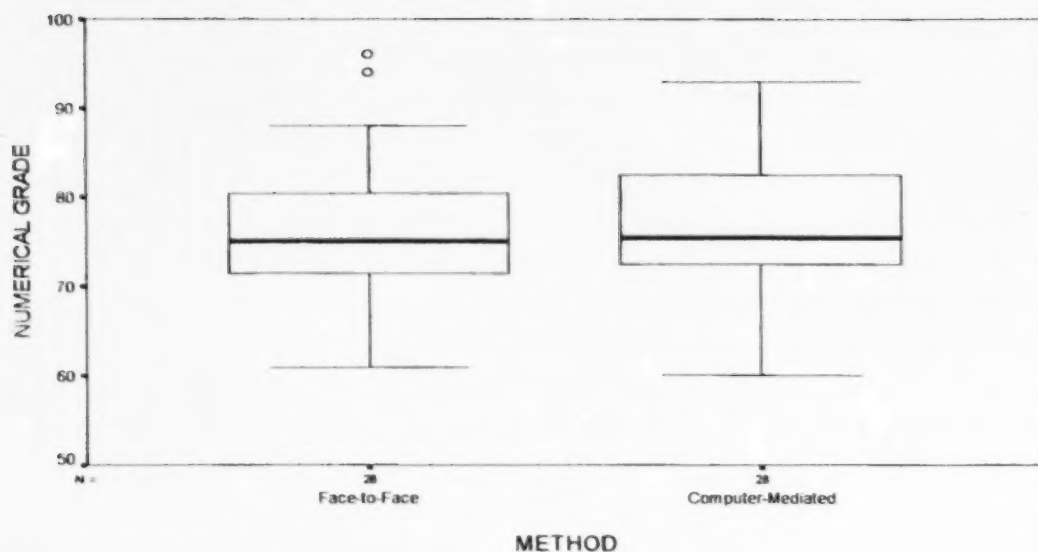


Figure 1: Mathematics Grade versus Tutoring Method

### Conclusions

The following conclusions can be drawn within the limitations of this comparative study:

1. In this study, there was no statistically significant difference between the face-to-face and the computer-mediated tutored students' mathematical achievement as judged by the results of the Student t-test performed on the data. Therefore, it cannot be concluded that there is a difference in the mathematical achievement of students tutored face-to-face and through electronic mail. As students have more access to computers, teachers who do not have the time nor space during school hours to tutor students, might be able to establish a schedule in which students can receive computer-mediated tutoring.

2. In this study, there was no statistically significant difference between the students who had less than 10 tutoring sessions and students who had more than 10 tutoring sessions with respect to their mathematical achievement. The amount of sessions seems to have no effect on the students' mathematical achievement. Tutoring sessions are determined by the need of a clarification of a concept or procedure, an explanation on the application of a concept, or a question on why they could not get the correct answer.

#### Implications

The implications of these findings are that computer-mediated tutoring can be as effective as face-to-face tutoring in mathematical concepts, for it was found that there was no significant difference between the face-to-face and the computer-mediated tutored students' mathematical achievement. These findings might help the teaching profession because it gives teachers a way to complement the traditional face-to-face tutoring with computer-mediated tutoring. Teachers find themselves restricted by the lack of time and space during school hours. Students, who take the school bus to school, find it impossible to arrive earlier or to stay after school. Having access to a computer at home or at the public library, allows the student to be tutored after school hours.

Computer-mediated tutoring is a version of the proven face-to-face tutoring that takes place in the electronic world of electronic mail without being bounded by time and location. It is the desire of the researcher that computer-mediated tutoring be viewed only as a way of *complementing* face-to-face tutoring. Face-to-face tutoring allows for the interpretation of body language, which in turn allows the tutor to pace the tutoring session accordingly. In the computer-mediated sessions, the teacher responds to the

question posed by the student without knowing if too little or too much of the answer is being given. Only when the student responds to the explanation will the teacher know if more is needed.

The conclusions from this study are the basis for the following recommendations. These can be divided into two categories: recommendations for future educational practice and recommendations for future research and theory:

#### Recommendations

##### *Recommendations for Future Educational Practice*

1. Teachers should offer computer-mediated tutoring to students who are not performing well, especially when face-to-face tutoring is not easily available.
2. Schools should establish web sites and provide teachers with electronic mail addresses that will allow students to communicate with them after school hours.

##### *Recommendations for Future Research and Theory*

1. The achievement of students should be studied in other areas or courses.
2. The achievement of students attending different schools should be studied.
3. This study should be conducted during a longer period of time such as a semester.
4. The study should involve a larger number of students from a specific mathematics course.

As more students have access to computers, be it at home, public libraries, or school computer labs, and as more teachers provide students with their electronic mail addresses, classroom instruction could be complemented, after school hours, electronically. Future studies might explore the attitudes of students and teachers concerning computer-

mediated tutoring as well as a descriptive study regarding students' availability of computers.

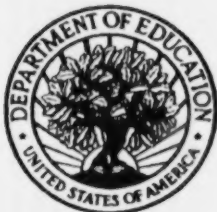
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